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Clinical Study

Outcomes of extended transforaminal lumbar interbody fusion for lumbar spondylosis

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ABSTRACT

This study aims to assess the results of extended transforaminal lumbar interbody fusion (TLIF) for a two surgeon, single institution series. In total, extended TLIF with bilateral decompression was performed in 57 patients. Pain, American Spinal Injury Association scores, patient demographics, body mass index (BMI), perioperative indices and radiographic measurements were recorded and analysed. The surgeries were performed between February 2011 and January 2014 on 38 women and 19 men. The mean patient age was 62.86 years, and the mean BMI was 30.31 kg/m^2. In 49 patients, spondylolisthesis was the primary indication. The mean intraoperative time was 284.65 min, and this decreased as the series progressed. The median length of stay was 5 days (range: 2–9). The surgical complication rate was 19.3%. Two patients died from cardiopulmonary complications. Single level TLIF was performed in 78.9% of the cohort, with L4/5 the most commonly fused level. Significant pain reduction was achieved from a mean (±standard deviation) preoperative visual analogue scale (VAS) of 8.28 ± 1.39 to 1.50 ± 1.05 at 12 months postoperatively. No patients deteriorated neurologically. Spondylolisthesis was significantly corrected from a preoperative mean of 6.82 mm to 2.80 mm postoperatively. Although there is a learning curve associated with the procedure, extended TLIF with bilateral facet joint removal and decompression appeared to be a safe and effective alternative to other fusion techniques, and our results were comparable to other published case series. The stabilisation and correction of spinal deformity reduces pain, aids neurologic recovery and improves quality of life.

1. Introduction

Fusion of the spine was first described in 1911 by Albee et al. as an operation for Pott's disease, using a tibial graft for stabilization, [1] and by Hibbs et al. for stabilizing spinal deformities such as scoliosis [2]. Chandler et al. were the first to use spinal fusion for treatment of lower back pain and sciatica [3]. Barr proposed the combined use of discectomy and fusion to overcome the problem of discectomy alone, which left patients with residual pain due to underlying structural disc weakness [4].

Lumbar interbody fusion is now an accepted treatment for a variety of spinal disorders including trauma, infectious and neoplastic conditions [5]. It involves placement of an implant (spacer, graft or cage) within the intervertebral space, after a discectomy and end plate preparation. Currently, lumbar interbody fusion is performed using four main approaches, posterior (PLIF), transforaminal (TLIF), anterior (ALIF), and lateral (LLIF). There is no evidence that one approach is superior to the others. These operations can also be performed using mini-open or minimally invasive (MIS) approaches [6]. Interbody fusion has been reported to have lower rates of postoperative complications and pseudoarthrosis [7,8].

Posterolateral fusion places the graft in the posterolateral gutter to allow fusion from one transverse process to another. This avoids stenosis, which can be caused by a direct posterior approach to fusion [10,9]. The TLIF, a modified and unilateral approach to the PLIF, was first described by Harms et al. in 1982 [11]. It gained popularity after further work by Harms et al. in the 1990s [12]. The technique was developed with the view to achieve a circumferential fusion, with minimal risk to neural structures or the need for two staged operations. Retraction on the neural structures in TLIF is less than PLIF, and hence, can be safely performed above L2 as there is less conus medullaris retraction and risk for injury. TLIF preserves the interspinous ligament and spinous processes posterior to the thecal sac, as well as other midline structural supports

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[13]. TLIF may be preferable for revision surgery of a prior posterior approach, especially when an anterior approach is problematic or the surgeon is not familiar with ALIF. These benefits have led to TLIF becoming increasingly popular over the last 15 years. Multiple versions of this technique have now emerged including unilateral instrumented fusion, unilateral pedicle screws with contralateral facet screws and, more recently, MIS techniques for interbody fusion with bilateral pedicle screws, with or without a posterolateral fusion [14–17]. The limitations of TLIF include the significant muscle retraction and dissection, which can lead to postoperative pain, and delayed rehabilitation and impaired long term spinal motion [18]. Although we have listed the benefits here, and this is the authors' preferred fusion technique, there is no evidence of any benefit of TLIF over other fusion techniques in long term studies of clinical symptoms and fusion rates.

The present study examines the experience of a two surgeon series with an extended TLIF for degenerative spinal disease. This technique is in contrast to the traditional TLIF, previously described by Hackenberg et al. and others [12,30,22], where the access to the intervertebral space is gained by unilateral facet joint resection. The traditional TLIF technique utilises a more minimal decompression than the extended TLIF described herein.

2. Methods

This is a retrospective study of 57 patients with extended TLIF, performed by the authors from February 2011 to January 2014. All patients had pre- and postoperative CT scans of the affected spinal area. The American Spinal Injury Association (ASIA) impairment score was used to document neurological function. The visual analog scale (VAS) was used to assess the level of pain before and after surgery. Pain was subclassified into severe (VAS 7–10), moderate (VAS 5–6) and mild (VAS 0–4). The Cobb angle was used to measure the degree of lumbar lordosis. The distance of antero- or retrolisthesis was measured at the level of fusion before and after surgery, using midsagittal CT scan slices. The perioperative complications, pre- and postoperative neurological function and pain were analysed. Informed consent was obtained from all patients in accordance with institutional policy.

2.1. Surgical technique: Extended TLIF

All patients were anaesthetised with an endotracheal general anaesthetic and placed prone on a Wilson frame. Radiographs were then taken to localise the pathological level. Preparation and draping was completed in the usual fashion. A midline incision was made and dissection was then made to expose the spine. The paraspinal muscles were retracted in a subperiosteal fashion to expose the laminae of the affected segments. Under image intensifier guidance, pedicle screws were inserted into the bodies of the vertebrae one level above and below the pathological level. Bilateral decompression was then carried out by removing the left and right facet joints and completing a laminectomy at each affected level. A discectomy and end plate preparation was then performed through the transforaminal windows, created by removing the facet joints. Bone graft was then packed into the disc spaces to be fused before a banana shaped poly ethyl ethyl ketone (PEEK) cage was inserted into the disc space. Rods were then placed bilaterally to connect the pedicle screws, and a reduction manoeuvre performed to reduce spondylolisthesis, if present. Screws were then locked after compression and one cross-link with two parts was placed. Further bone graft was then packed into the interspace, as required. Haemostasis was then achieved and the wound was closed in multiple layers. Then, postoperative CT scans were obtained. Figure 1 shows an illustrative patient.

3. Results

3.1. Clinical data

In total, 57 patients were included in this study, 19 men and 38 women. The mean age of the patients was 62.86 years (range: 25–82). The mean body mass index (BMI) for all patients was 30.31 kg/m^2 (range: 20–51), for the men it was 28.46 kg/m^2 and for the women 31.16 kg/m^2. Two patients had emergency surgery, one for an acute foot drop (Patient 35), and another due to cauda equina syndrome (Patient 47). The remaining 55 had elective procedures, of which 49 patients (86%) had spondylolisthesis as the primary indication for surgery, 28 of whom had concomitant central canal stenosis and five concomitant foraminal stenosis. Apart from the two patients who presented emergently, the remaining patients all presented with lower back pain and radicular lower limb pain. Table 1 demonstrates the clinical, radiographic and operative data for our series. Table 2 stratifies these results by comparing the single and multiple level TLIF. There were no significant differences in the perioperative indices or VAS scores between these two groups.

3.2. Operative time and estimated blood loss

The length of operating time and estimated blood loss was taken from the intraoperative anaesthetic charts for these patients. The estimated blood loss was only able to collected for 21 patients (35.6%), therefore, it was excluded from this report. The mean operating time was 284.65 min (range: 150–600).

3.3. Complications and length of stay (LOS)

The median LOS was 5 days (range: 2–9), excluding two patients who were outliers. Patient 9 suffered a myocardial infarction associated with a prolonged operation and was, therefore, an inpatient for 56 days at our institution. However, this patient was transferred from the neurosurgical ward to a rehabilitation unit at 14 days postoperatively. Patient 38 died whilst they were an inpatient on day 6 postoperatively from a deep venous thrombosis and pulmonary embolus.

Postoperative complications were encountered by 19 patients (33.3%). The most common of these was anaemia, requiring a postoperative transfusion and occurring in eight patients (14.0%). Two patients (3.5%) had wound infections in the immediate postoperative period, only one of which required CT scan-guided aspiration. Both were treated with appropriate antibiotics for 6 weeks. Patient 47 had postoperative hypotension and was admitted to an intensive care unit for circulatory support. Patient 10 had pressure sores on her breast and airway oedema from a prolonged operation in the prone position. Patient 28 had a pseudomeningocoele that developed postoperatively. Two patients encountered cardiopulmonary complications, as previously mentioned. Table 3 lists all the postoperative complications from our cohort.

3.4. Spinal levels

One level TLIF was performed in 45 patients (78.9%), 11 patients (19.3%) underwent two level TLIF, and one patient (1.8%) had a three level TLIF. The most commonly affected level was L4/5 in 44 patients (77.2%), followed by L3/4 in 15 (26.3%), L5/S1 in 11, and L2/3 in four.

3.5. Pain score

There was a significant reduction of pain from the mean (±standard deviation) preoperative VAS of 8.28 ± 1.39 to a postoperative